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ABSTRACT

This document reports the results of a study that assessed the effects of Information and Communications Technology (ICT) on students' skills and knowledge. The study analyzes the effect of using ICT on students' skills, motivation, and attitudes, and describes teachers' experiences with and views on the potential of ICT. (YDS)

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Interchange 63

The impact of Information and Communications Technology initiatives

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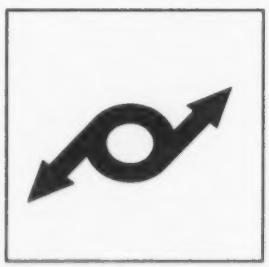

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The impact of Information and Communications Technology initiatives

Rae Stark (University of Strathclyde), Mary Simpson (University of Edinburgh), Donald Gray (University of Strathclyde), Fran Payne (Northern College)

Introduction

This Interchange reports the interim findings of a study designed to assess the impact of a variety of Information and Communications Technology (ICT) initiatives on pupils' skills and knowledge. The study, commissioned by the Scottish Office Education and Industry Department in 1998, is being carried out by a team drawn from the Universities of Strathclyde and Edinburgh and Northern College

Background

The initiatives assessed by this study, taken together, show a considerable investment in training, hardware and infrastructure, and have three main aims.

1. To increase the amount of up-to-date ICT equipment in schools and improve access to it

These aims are being met through some of the following resource allocations:

- funding for ICT and buildings (£115.7 million over five years from 1997)
- the Comprehensive Spending review (£62 million made available to build the National Grid for Learning (NGfL) in Scottish schools, from 1998–2002)
- (from March 1999) the Capital Modernisation Fund (£20 million to increase the number of computers in primary schools).

Many teachers have been supported in buying their own computers, and targets have been set for levels of provision for modern desktop computer equipment – the aim is to achieve computer ratios of five pupils to one computer in secondary schools and two computers to every 15 primary pupils.

2. To improve the resources available to support classroom work (especially on-line resources)

The following initiatives sought to meet this aim:

- the Money for Schools allocation of £15 million in the 1998 budget was intended to be applied to a range of improvement initiatives, including support for the NGfL pilot schools
- the SuperHighways Task Force has produced the publication *ICT and*

Development Planning to assist schools in the purposeful and phased introduction of ICT into their classrooms and their administrative and management processes

- the Scottish Virtual Teachers' Centre has been established by the Scottish Council for Educational Technology (SCET)/Scottish Consultative Council on the Curriculum (SCCC) to offer teachers access to a range of curriculum resources and pointers towards known, relevant, on-line resources and sites
- a full-time specialist team has now been set-up including five national specialists in the following areas: Educational Content, Community Education, Training and Development, Infrastructure, and a Scottish Virtual Teachers' Centre (SVTC) Consultant. In addition, a NGfL Customer Support Executive has been appointed.

3. To enhance staff skills in the use of ICT to deliver the curriculum

- New Opportunities Funding is intended to provide appropriate staff development in tandem with new hardware, software and access to the NGfL (£23m during April 1999–2002). Schools and authorities will choose from a range of validated training providers whose courses focus on the use of ICT to deliver the existing curriculum rather than on acquiring ICT skills and competences alone.

Monitoring the impact of the ICT initiatives on Scottish schools

This study was established to determine the extent to which the above aims are being met. To do this, two national surveys of Scottish schools are being undertaken, the first (Phase 1) in 1999–2000, just before the initiatives are introduced, and the second (Phase 2) in 2000–01 when they are beginning to make an impact. It is anticipated that indicators of any impact would include:

- enhanced learning experiences for pupils through the use of ICT
- increased motivation for both learners and teachers
- greater use of ICT in the classroom for both teachers and pupils
- higher levels of pupil attainment as a consequence of increased motivation and enhanced learning experiences
- the emergence of online communities of both learners and teachers
- a greater access to external teaching resources
- an increase in network literacy for both teachers and pupils
- a greater use of basic network skills in routine classroom learning work
- a greater use of ICT for learner, staff, and parent support
- greater use of ICT in managing information and data relevant to assessment, recording, reporting, monitoring and evaluation.

Some of these indicators are more readily identifiable than others and some will only be evident some time down the line; the 1999–2000 findings provide baseline measures against which future progress can be measured.

The study

In order to gather baseline data on performance, provision and usage, it was necessary to undertake four main tasks:

- the development of an assessment framework – for use in the compilation of tasks to assess three aspects of the pupils' ICT proficiency. These were 'Knowledge and understanding', 'Practical competency' and 'Personal appropriation'. These were assessed across four strands: ICT hardware; software applications; communications networks; and the societal uses and impact of ICT. The framework was also used to inform the development of the staff and pupil questionnaires
- the development of written assessment tasks to gather information on pupils' ICT knowledge and skills – these were initially piloted in January 1999 and the first national survey of performance at Primary 7 and Secondary 4 took place in April and May 1999. They covered 'Knowledge and understanding' and 'Personal appropriation'
- the development of practical assessment tasks to provide information on the proficiency of P7 and S4 pupils on a range of key practical ICT operations – designed to assess competence in four areas of ICT. These were word processing; databases and spreadsheets; using CD ROMs; and, lastly, using the WWW and e-mail. The tasks were compiled into short booklets, one for each of the four aspects identified
- seeking information on the perceptions, experiences and skills of staff and pupils, focusing on key aspects of the initiatives and their intended outcomes – questionnaires were devised to gather the information from three groups. These were primary and secondary classroom teachers; school managers/ICT co-ordinators (primary and secondary); and P7 and S4 pupils.

Pupils' ICT knowledge and skills

Written tests were administered to samples of pupils in Primary 7 and Secondary 4 in Scottish schools to determine their understanding of and competences in ICT. Practical tasks were administered to Primary 7 pupils only. (The survey was undertaken in April–May when many S4 pupils were involved in assessment for external certification.)

Overall, P7 pupils were successful in 40 to 60 per cent of the items tackled in the written tests while S4 pupils achieved success at levels of 60 to 70 per cent. These generalisations mask considerable variations within the sub-categories of the assessment framework.

Knowledge and understanding

The majority of the tasks set within this sub-category involved knowledge of hardware, software, communications networks and the uses and impact of ICT. Scores for knowledge of hardware were highest for both groups of pupils (P7 – 56 per cent; S4 – 70 per cent). At P7, knowledge of software applications was marginally lower (55 per cent), with communications networks (47 per cent) and uses and impact (45 per cent) following.

At S4, knowledge of the uses and impact of ICT was strong (also 70 per cent), with communications networks (63 per cent) and software applications (61 per cent) also above the midpoint.

At both stages, knowledge of the names of elements of hardware and software applications was relatively secure. Their understanding of the significance of some aspects of ICT was less secure: for example, approximately one third of P7 and one half of S4 pupils knew what the 'millennium bug' was.

Personal appropriation

Personal appropriation, the ability to identify and use appropriate strategies to complete a task, was also assessed through the written papers, although the numbers of such tasks were relatively limited (six at P7; seven at S4). At P7, scores ranged from 28 per cent on communications networks to 43 per cent on hardware while at S4, pupils achieved 47 per cent on communications and 61 per cent on the hardware tasks.

Practical competence

This category was assessed at P7 only. While schools were willing to participate in this aspect of the survey, incompatibility of equipment, platforms and applications resulted in a smaller data gathering exercise than was originally anticipated. Performance varied considerably from school to school.

Performance levels were highest on the word processing tasks (just over 50 per cent), with CD-ROM and spreadsheets following in turn (41 per cent and 33 per cent respectively). Many schools were not yet connected to the Internet and as a result, use of the WWW and e-mailing skills could not be assessed.

Comparing Primary 7 and Secondary 4

Thirty-five of the tasks used were common to written test booklets at both stages, allowing comparison of performance across the stages. The older pupils were more successful on 25 of these tasks, with P7 performing better on the remaining 10 (although for one task, the difference was marginal). Where the younger group did better, the tasks focused on using graphics applications and knowledge of ICT communication.

Perceptions of school staff and pupils

The ICT co-ordinator bears the main responsibility for planning the introduction of ICT into teaching and administration within the school. In primary schools, only a small proportion of those holding the ICT remit had any formal qualification in ICT and the majority had been in post for over 16 years. In secondary schools, 70 per cent had experienced some formal ICT training within their computing, technical, or business studies qualifications.

Remits and training needs

Although the majority of ICT co-ordinators in the primary (P) and secondary (S) sectors were responsible for disseminating information on ICT resources, rather more primary staff advised colleagues on the use ICT in teaching and learning (75 per cent P; 54 per cent S) and on the purchase of software (84 per cent P, 64 per cent S). In secondary schools, ICT co-ordinators more frequently were involved in running staff development activities, managing school ICT committee work, and liaising with the education authority on ICT initiatives and developments (81 per cent S; 42 per cent P).

The training needs identified by more than half both groups of respondents were the use of ICT as a general teaching tool and the WWW and e-mail for educational purposes. More secondary respondents indicated a need for training with respect to the management of a school development policy (85 per cent S; 64 per cent P), and the setting up of Local Area Networks (54 per cent S; 37 per cent P).

Sources of support

For primary staff, the most frequently reported source of support was local authority staff while for secondary respondents it was colleagues in their own school. The Scottish Council for Educational Technology (SCET) was identified by 40 per cent in both sectors as a source of support but the Scottish Virtual Teachers' Centre (SVTC) was identified by only 3 to 4 per cent of respondents.

Development of policy and planning

Around half of the primary schools and two thirds of the secondary schools had a written policy for ICT and were working to put it into practice – only a minority of these, however, reflected the most recent national initiatives. While for both sectors, staff development and improvement of access were the main priorities, rather more mention was made by primary staff of curricular and learning aspects of ICT use, for example developing pupils' and teachers' use of e-mail. More frequent mention was made by secondary staff of management-related priorities, for example the development of administrative systems.

Staff attitudes to ICT vary widely, but there is a definite gradual shift in a positive direction. The issue of staff training is crucial. Beginners always find they forget how to do things unless they use them regularly. We now have better access to the hardware – the training must follow. [Primary ICT Co-ordinator]

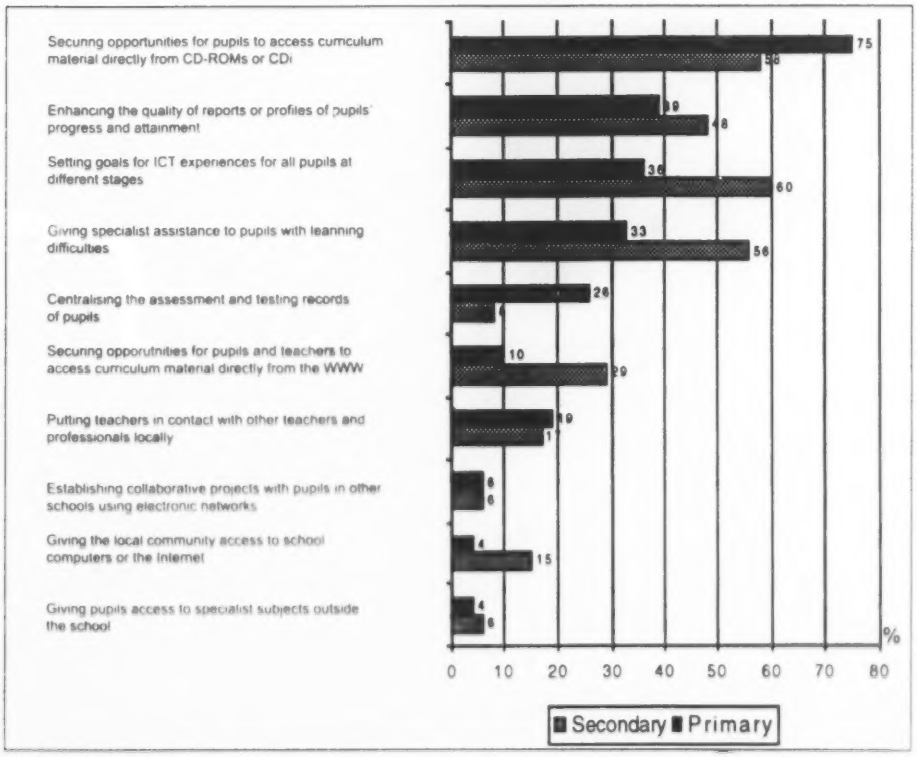
Current action

In primary schools, most effort was being dedicated to supporting learning and teaching, and in securing opportunities for pupils and teachers to access curriculum material directly from CDi and CD-ROMs.

In just over half of secondary schools, action was under way on establishing access to CD-ROMs, setting ICT goals for pupils and giving assistance to pupils with learning difficulties. Centralisation of assessment records was rather more advanced in some primaries than in secondaries.

Communications with the wider community – whether parents, professional colleagues, pupil peer groups or the local community – were not very far advanced in their development. Thirty-eight per cent of secondary schools and 5 per cent of primaries reported having their own web site. See Figure 1.

Figure 1: Stages of development (primary and secondary) – Activities established or in the process of being established


Securing opportunities for pupils to access curriculum material directly from CD-ROMs or CDi
75
58
Enhancing the quality of reports or profiles of pupils' progress and attainment
39
48
Setting goals for ICT experiences for all pupils at different stages
36
60
Giving specialist assistance to pupils with learning difficulties
33
58
Centralising the assessment and testing records of pupils
26
4
Securing opportunities for pupils and teachers to access curriculum material directly from the WWW
10
29
Putting teachers in contact with other teachers and professionals locally
19
1
Establishing collaborative projects with pupils in other schools using electronic networks
6
6
Giving the local community access to school computers or the Internet
4
15
Giving pupils access to specialist subjects outside the school
4
6
%
0 10 20 30 40 50 60 70 80
Secondary Primary

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Aspirations for the future

The majority of co-ordinators in both sectors indicated that they expected significant changes over the coming two to three years. They expected to:

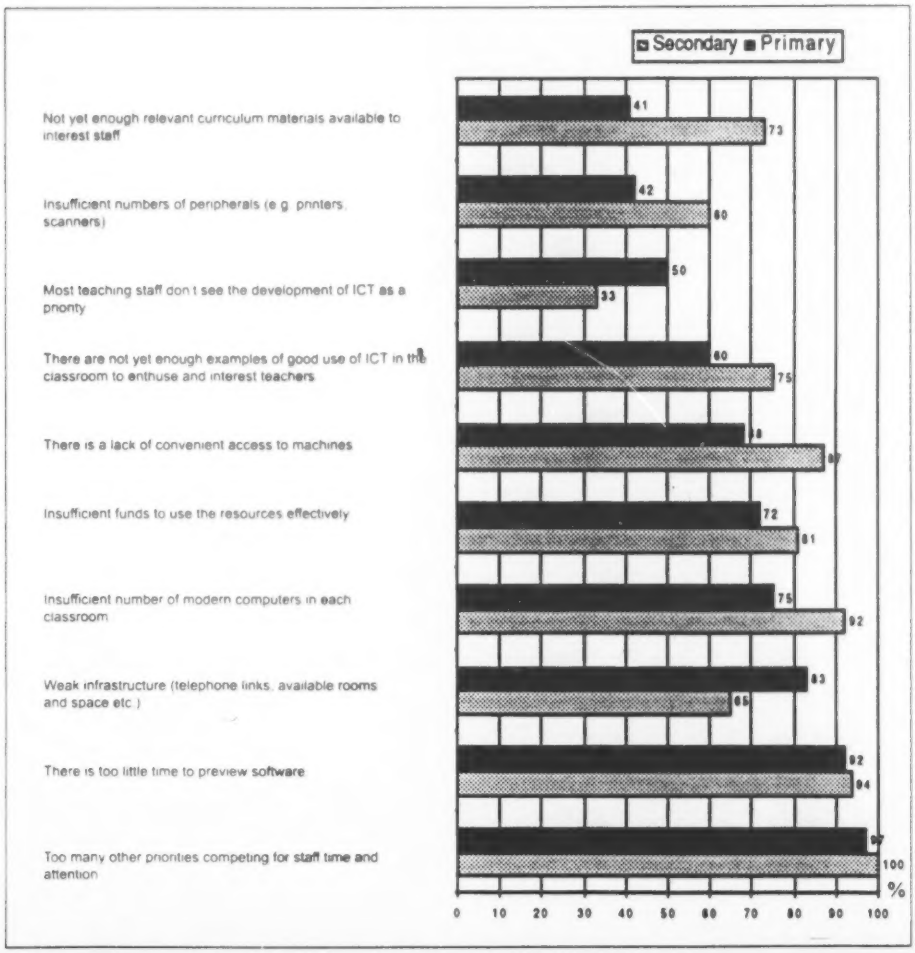
- have a number of modern computers in every classroom
- have staff trained in a range of ICT uses in classrooms
- have developed a common vision on the use of computers in their school
- be seeing positive effects of ICT on pupil attainment.

However, pupils accessing information from specialists outside the school, and teachers being in regular ICT communications with parents, were not on the agenda for development in the foreseeable future.

Obstacles to the development of ICT in schools

The obstacles indicated by more than half of the respondents are set out in Figure 2.

Figure 2: obstacles to ICT use (primary and secondary)



Competing priorities, lack of technical support, time, and underdeveloped skills were among the most frequently mentioned items in both sectors. These are all aspects that are recognised centrally and are being addressed through various elements of the central programme.

Very positive about ICT – especially when we will shortly be looking at the Internet. Drawback – this area takes up a considerable amount of teachers' own time - especially as we all have Macs at home. (Primary teacher)

The most positive benefits of the introduction of ICT

The main benefits identified by respondents were:

- improved motivation – was cited most frequently, with references to increased pupil motivation, the further development of ICT skills, and better preparation for the world of work. Also mentioned were improvements in the presentation of work, its quality and levels of attainment. Comments included: 'Children with writing problems becoming proud of their work.' 'Pupils want to use ICT – they feel it is part of the "real world"', and 'support for SEN pupils'
- enhancement of learning – for example, the opportunity to learn at a different pace; more fun and more directly targeted, ownership of learning – for both pupils and staff. 'Computers are objective – pupils are not threatened by them. We use Success Maker – this is an excellent medium for pupils who find work threatening.'
- enhancement of teaching – for example, using a greater variety of teaching methods; extending opportunities for both pupils and staff. 'Provides an extra "teacher" in the room.' 'Re-awakening a learning culture among the staff.'
- improved communications – both for pupils (e.g. learning other languages) and for teachers, (e.g. in the sharing of resources). 'Opportunity to use video-conferencing and e-mail and to link with parents for homework/ information etc.'
- improved access to information – particularly through the use of the Internet, CD-ROMs etc. 'Access to a wealth of information to support all curricular areas.' 'Ease of access of up-to-date information, i.e. via the Internet, and of opportunities for research.'
- improved efficiency – in management and administration, for example different ways of gathering information; reducing time spent on routine administration tasks. 'Keeping up to date alongside businesses and non-educational institutions.' 'Speed, accuracy, reliability of data accessing and storing data across the curriculum.' 'ICT can be highly individual and will, I think, eventually free teachers to do other "teacher" tasks.'
- promotion of independence – 'an extension in the range of teaching and learning strategies leading to more independent learning at an appropriate level.' 'The computer as a means of giving independence to children – allowing them to play games, access to CD-ROMs for information etc.'

We are very positive about ICT. Give us the time and resources and we'll deliver. (Secondary teacher)

The experiences and perceptions of the teaching staff

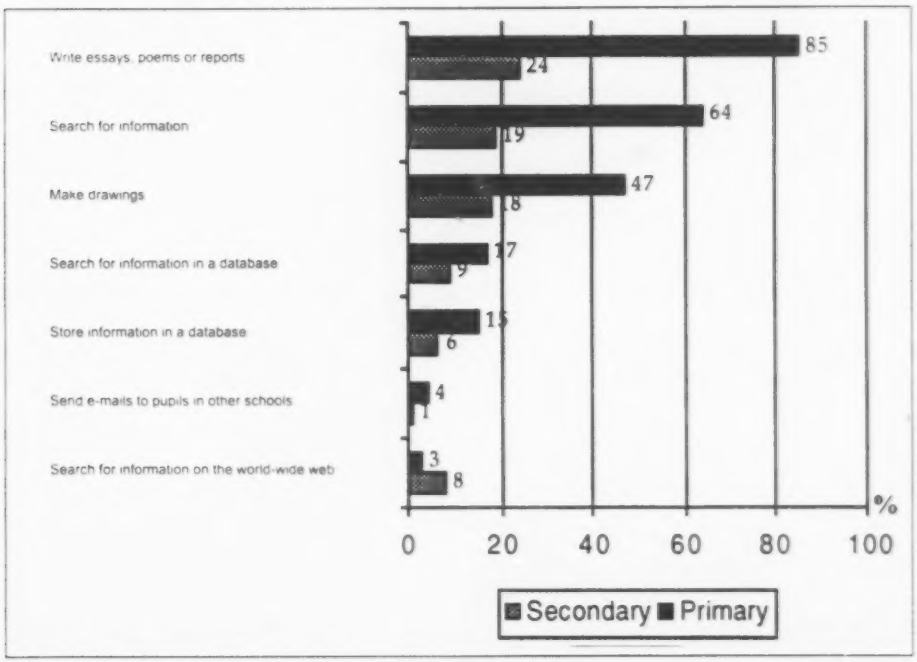
A sample of primary and secondary classroom teachers completed questionnaires on provision, usage and intentions for ICT in the classroom and wider school.

Teachers' experience of using ICT

Around 70 per cent in both sectors indicated that they used a computer at home: word processing for the purposes of schoolwork was the most frequently identified use, just under half used CD-ROM, graphics and databases. Around half had never used the WWW or e-mail.

Because of differences in subject areas in secondary schools the overall data are not fully comparable with the primary ones. Nevertheless, Figure 3 gives an interesting picture of some of the differences in the two sectors, for example in the use by pupils of CD-ROM. *'Search for information'* was reported as already well established by 64 per cent of primary teacher respondents, but by only 19 per cent of secondary teachers. Half of the latter expect to introduce this activity over the next two years. The use of the WWW by pupils to access information was regarded as irrelevant to their subject, or not on their development plan by 42 per cent of secondary teachers.

Figure 3: Pupils' use of ICT in the classroom –
'In my classroom, pupils use a computer to . . .'



Teachers' views on the potential of ICT

Overall, the teachers' views on the potential impact of ICT on the pupils, the staff and the schools were remarkably similar across the two sectors, but different teachers anticipated different kinds of benefits:

- streamlining current procedures (for example, preparing pupil worksheets; recording pupil data and profiling; analysing test results)
- gaining access to novel professional opportunities such as joining in virtual meetings with colleagues in other schools and video-conferencing
- using exciting new teaching opportunities (for example son et lumière presentations to supplement the teaching of literature; creating multimedia presentations).

The pupils' views and experiences of ICT

Samples of P7 and S4 pupils completed questionnaires on their views of ICT, how they used it and what for. The data from the questionnaires complements those from the assessment component of the study.

Pupils' attitudes and skills

In both sectors around 80 per cent of pupils indicated that outside of school they had, by some means, access to computers that performed functions other than running games packages. The increasing availability of such technology in the domestic market is perhaps also reflected in the differences noted between pupils in the two sectors with respect to where they acquired their knowledge and skills. Most primary pupils indicated that they acquired their skills at home; for most secondary pupils this occurred in school.

Using computers at home and in school

In both sectors ICT was used by pupils for word processing and drawing, both in school and at home. Secondary pupils used databases, spreadsheets and the WWW most frequently in schools whereas primary pupils used word processing, drawing, CD-ROM and simulations most often. The frequency of use of computing facilities at home was generally lower than at school, but there was evidence of a wide range of usage, from word processing to digital photography. More pupils indicated the use of e-mail at home (24 to 29 per cent) than at school (10 to 11 per cent).

Likes and dislikes about using computers

In the open responses, primary pupils most frequently liked fun and games: 'It's really fun to use; they have great games.' From the secondary pupils, the most frequent responses referred to presentation and efficiency: 'my work is not so

messy', '. . . easier to change and edit', '. . .efficient for essay writing', and '. . . neater presentation of my work.'

Knowing what programme to use and poor typing skills were the most frequently cited difficulties by secondary pupils: '. . . typing, because I'm too slow', '. . . learning how to type with both hands in the beginning.' Frustrations at technical difficulties which were difficult to deal with figured most prominently in the primary responses: '. . . when something goes wrong and you don't know what to do', '. . . when something crashes and stays there', and '. . . when the computer gets jammed and the reset button doesn't work.'

Both pupils and teachers wanted computers for the same things, for example, the Internet and e-mail, which were by far the most frequently mentioned by both primary and secondary pupils. '. . . know more about the Internet', '. . . talk to people on the Internet', '. . . be able to send and receive e-mail and faxes', '. . . mail friends in other schools', and '. . . talk to people around the country.' '. . . Try different things other than typing' was the response of one secondary pupil, and '. . . nothing – I'd rather be playing football' was the response of two primary pupils.

The importance of learning to use a computer

Fifty to 60 per cent thought it was important, and 30 to 40 per cent thought it very important. The overwhelming majority of pupils in both groups said that computer knowledge would be necessary or useful for gaining future employment. '. . . In most jobs you will use a computer', '. . . the pay is good if you do something with computers', '. . . if you want to be a secretary, you have more job prospects if you can use a computer properly.' This was followed in frequency by observations about the permeation of computers throughout life in general: '. . . computers are fast becoming part of everyday life', '. . . computers are a thing of the modern world', '. . . in the future most things will be run by computers.'

Summary

This study was set up to provide baseline data at the introduction of a series of ICT initiatives in Scottish schools and to consider, two years later, the extent of the impact of those initiatives. The study is currently at its mid-point but the first phase has established a basis for comparison across a range of measurements. First, it has provided evidence of the range of knowledge and skills which pupils already possess. The picture shows some variation, with some pupils demonstrating considerable expertise (for example mounting the school's web pages) while others are virtually illiterate when it comes to using computers; overall they got about half of the questions right. The evidence is that word processing, graphics packages and information searching (through CD-ROMs and the Internet) are among the most frequent ICT uses.

Teachers are similarly varied in their confidence and competence in using the range of ICT opportunities available to them but the majority remained positive and saw advantages in developing further their skills and understanding. They clearly need support in doing this – however, computer competence is not the aim. Teachers see the main benefits lying in the development of learning and teaching strategies which take advantage of the opportunities provided by the ICT initiatives. The second survey is due to take place during 2000–01; the data gathered then should give some indication as to how effectively the initiatives are meeting the aspirations of teachers and pupils in Scottish schools.

The full report, *The Impact of ICT Intitiatives in Scottish Schools*, is available from the Impact of ICT Initiatives Project, Smith Building, Faculty of Education, University of Strathclyde, price £10.00.

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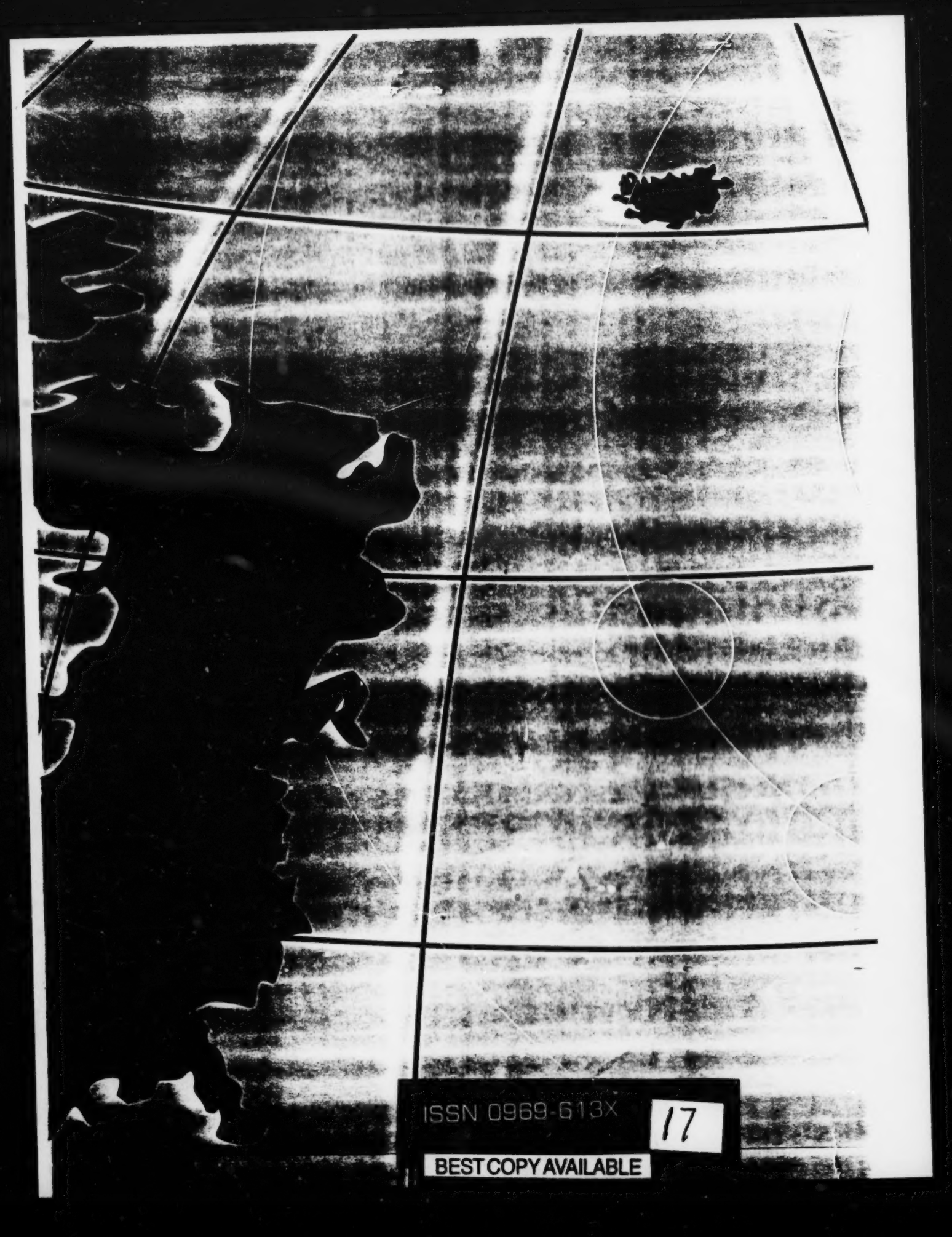

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